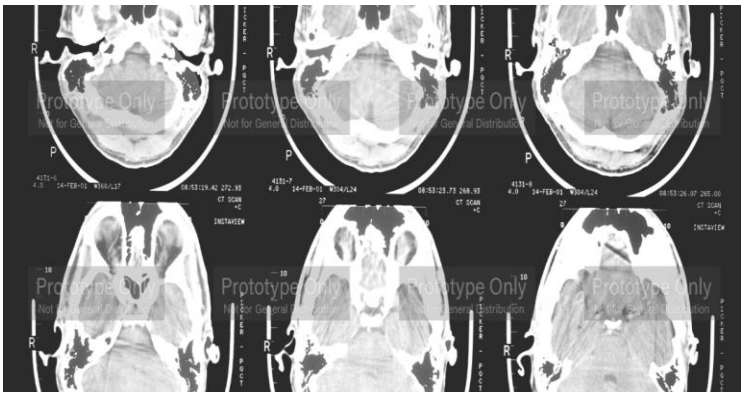
Case Study : New insights into brain disruptions in schizophrenia



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https://www.bps.org.uk/research-digest/new-insights-brain-disruptions-schizophrenia

Article

People with schizophrenia can find it difficult to perceive and think about the world in the same way as those without the disorder; symptoms are wide-ranging, and include hallucinations, delusions, and/or disorganised speech. And, while much research has tried to get to the bottom of what causes these symptoms, the exact changes that lead to the development of schizophrenia are still being explored.

Some studies have found differences in the brains of people with schizophrenia in what's known as the 'primary sensorimotor-to-association axis'. In those without schizophrenia, these connections allow information from regions of the cortex that separately handle visual signals, sounds, touch, and body movements to be properly integrated. Researchers have suggested that disruptions to this aspect of brain organisation might help to explain some of the symptoms of schizophrenia, including delusions. However, a new paper in Biological Psychiatry: CNNI suggests that disruption to another set of connections might also be involved.

In their study, Alexander Holmes at Monash University, Australia, and colleagues analysed two sets of fMRI scans. One set consisted of brain scans from 114 patients with early psychosis and 48 healthy control participants. The other set consisted of scans of 50 patients with established schizophrenia plus 121 controls.

After analysis, the team didn't find evidence of any abnormalities in this primary sensorimotor-to-association axis in the brains of people with schizophrenia — a finding that took them by surprise. This might be explained by differences in the severity of schizophrenia symptoms among patients in their group, compared with those in earlier studies, they suggest.

However, they did find that, compared with healthy participants and those in the early stages of psychosis, people with long-standing schizophrenia showed a key difference in what's known as the 'secondary visual-to-sensorimotor axis'.

In a healthy person, this enables the brain to use visual signals about what the body is doing to guide precise physical movements. The fact that this disruption was found only for those diagnosed with schizophrenia, but not for those with early psychosis, suggests that it emerges as the illness progresses. The researchers also found that these atypicalities were linked to higher clinical scores on specific aspects of schizophrenia, including delusions.

More work is certainly needed to better understand why these changes develop, and what they mean for the perceptions and thoughts of people with schizophrenia. But the team believes that, in future, targeting these changes may open up a new route to treatments for this disorder, which remains notoriously difficult to treat.

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Links to Specification

3.2.3 Other biological research methods

● Brain-scanning techniques (CAT, PET, and fMRI).

● The use of brain-scanning techniques to investigate human behaviour, e.g. aggression.

3.6 Issues and Debates: An understanding of how psychological understanding has developed over time (e.g. development of scanning techniques up to fMRI and development of knowledge accordingly).

5.1.3 Schizophrenia

● Description of symptoms and features, including thought insertion, hallucinations, delusions, disordered thinking.

● The function of neurotransmitters as a theory/explanation.

● One other biological theory/explanation.

Recommended revision and research activities:

1. What symptoms and features of schizophrenia are mentioned in the article? Which ones are not? Do you think it's significant that this research has focused on some symptoms and features and not others?

2. Find out more about differences in the primary sensorimotor-to-association axis as a biological explanation for schizophrenia. What are its strengths and limitations compared to other explanations? What does this study suggest about it as an explanation?

Challenge task: Research how our understanding of schizophrenia has developed over time. How have advances in technology including the use of PET and fMRI scans led to improvements in understanding?

Exam style questions*

1. Describe how fMRI scans can reveal differences in activity in a region of the brain such as the 'secondary visual-to-sensorimotor axis'. (3 marks)
2. Explain one ethical issue psychologists need to address when conducting this type of research. (3 marks)
3. Explain one strength and one limitation of using fMRI scans in a study such as this one. (4 marks)

(Click here to view Model Response sections)

Additional questions for which the content of the article can be used as part of a response

Assess one biological explanation for schizophrenia other than neurotransmitters. (8 marks)

To what extent have brain scanning techniques contributed to the development of psychological understanding over time? (8 marks)

*Exam style questions are not necessarily the exact format of those that will appear in the qualification examination papers but are written to elicit student responses that meet the assessment criteria, which are exemplified by the answers provided. The length of response in the answers is not indicative of expected student responses, and are provided to support centre teaching, student practice and self-assessment.

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Model Response - Click here to return to question page

Exam style questions:

1. **Describe how fMRI scans can reveal differences in activity in a region of the brain such as the 'secondary visual-to-sensorimotor axis'. (3 marks)**

- *fMRI scans give an indirect measure of brain activity by measuring changes in blood flow within the brain, related to the level of activity in specific areas and structures. Participants can be given tasks to perform inside the scanner involving visual signals guiding precise physical movements, for example controlling a stylus in response to visual cues presented on a screen. The change in blood flow in the secondary visual-to-somatosensory axis in participants with established schizophrenia (compared to a 'baseline' condition when they are not performing the task) can then be compared with changes in the control group.*

2. **Explain one ethical issue psychologists need to address when conducting this type of research. (3 marks)**

- *Psychologists carrying out research on participants with serious mental health issues need to be particularly careful to address the issue of informed consent. It is necessary for participants to fully understand the aims and procedures of the study before they can give this, but this may be difficult to ensure when participants have a schizophrenia diagnosis. The loss of accurate perception of reality and delusions common in schizophrenia mean that it may be necessary to involve family members and carry out additional checks of understanding.*

3. **Explain one strength and one limitation of using fMRI scans in a study such as this one. (4 marks)**

- *A strength of fMRI is that it can give 'real time' measures of activity across the brain as a whole while a task is being carried out. In this case, the ability to measure blood flow changes in the brain as a whole while sensorimotor tasks were carried out revealed not only that there was no difference in activity in the brains of participants with established schizophrenia in the expected area, but also that there were differences in another area.*

- *One limitation of fMRI is that while it measures brain activity (indirectly, through changes in blood flow), it is not possible to infer causation from this. In this case while there are differences in blood flow in the secondary visual-to-sensorimotor axis, this doesn't necessarily mean that any associated differences in neural activity here are a cause of any of the symptoms of schizophrenia – they could simply be correlated with these. It would be necessary to manipulate neural activity and observe the effects of this to establish a firm causal link.*

Marks awarded and commentary

Q1 This response would achieve full marks as it makes three accurate points about how an fMRI scan works. It measures blood flow in the brain (1), tasks are given to encourage blood flow (1) and activity can then be compared with healthy controls (1)

Q2 This response would gain the full 2 marks as it firstly identifies that informed consent is difficult to gain when using participants with mental health issues (1) and this is then justified by explaining that the loss in accurate perception of reality in schizophrenia would require family members to consent.

Q3 The strength achieves full marks as it identifies that measures can be gained 'across the brain as a whole'(1) and then justifies this as a strength by explaining that differences in other areas were established (1).

The limitation identifies the problem of causation between blood-flow, neural activity and symptoms of schizophrenia (1) and goes on to explain that because fMRIs don't manipulate neural activity they can't infer causation. (1)

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Model Responses - (Click here to return to question page)

Additional questions for which the content of the article can be used as part of a response

Assess one biological explanation for schizophrenia other than neurotransmitters. (8 marks)

The following paragraphs could form part of the answer to this question:

'AO1: One biological explanation for schizophrenia is abnormal functioning in specific brain structures. For example, researchers have found differences in the functioning of the brains of individuals with schizophrenia in the primary sensorimotor-to-association axis. These areas of the brain handle sensory data including visual signals, auditory (sounds), touch and body movements and integrate them. Abnormalities in the function of these areas can explain faulty information processing, hallucinations and delusions amongst other symptoms of schizophrenia.

AO3: Holmes et al tested the primary sensorimotor-to-association axis explanation using fMRI, and while they did not find supporting evidence for its involvement in schizophrenia, they did find abnormalities in related brain areas. Participants carried out a task in the scanner involving using visual cues to coordinate fine motor responses. Those with established schizophrenia differed from controls and those with early psychosis in terms of activity in their secondary visual-to-sensorimotor axis. They found that these differences were particularly linked to delusions. While this finding contradicts some earlier findings on the primary sensorimotor-to-association axis, they support the general idea that differences in brain function can explain key aspects of schizophrenia.

To what extent have brain scanning techniques contributed to the development of psychological understanding over time? (8 marks)

The following paragraphs could form part of the answer to this question:

AO1 (following paragraphs on earlier techniques): fMRI scans, developed in the 1990s, improved upon the PET technology. Again relying on measuring changes in blood flow as an indicator of neural activity, fMRI uses a powerful magnetic field to cause the nuclei of atoms in the body to align and interact with radio waves. This allows the production of a 3D representation of the brain, and in fMRI is used to measure the degree of oxygenation of haemoglobin in the blood, and hence show which areas of the brain are respiring actively. By comparing with a control condition the brain areas associated with a psychological function can then be identified. This technique offers improved spatial and temporal resolution than PET, and lower risk to participants as a radioactive tracer does not need to be used.

AO3: Many psychologists have argued that the development of functional imaging techniques such as PET and fMRI have completely transformed psychology by enabling the objective measurement of brain activity in human participants while they are performing a wide range of cognitive tasks. If we accept that human behaviour and experience arises from brain activity (as the great majority of psychologists do) then it follows that understanding how the brain is functioning is key to a full understanding of all psychological processes. However, critics of PET and fMRI point out that they are indirect measures of brain function as they actually measure blood flow. Furthermore, activity in a brain area does not necessarily mean it is essential for a function. Some psychologists therefore argue that experimentation with animals involving directly recording neural activity with electrodes inside the brain, and lesioning (deliberately damaging) areas of the brain to assess their functions, are still necessary aspects of research into human brain function.

Level awarded and commentary

Assess one biological explanation for schizophrenia other than neurotransmitters. (8 marks)

The first paragraph demonstrates accurate and thorough knowledge and understanding about the functions of the sensorimotor-to-association axis and the result of abnormalities of this structure.(AO1). Other similarly structured AO1 paragraphs might focus on enlarged ventricles, secondary visual-to-sensorimotor axis abnormalities and increased dopamine activity in mesolimbic or mesocortical pathways. The second paragraph (AO3) displays a well-developed and logical evaluation in the form of a supporting study by Holmes et al, presenting a conclusion that considers competing arguments in the form of earlier findings. Further, similarly structured paragraphs making use of supporting evidence or different explanations would lead to a Level 4 response overall.

To what extent have brain scanning techniques contributed to the development of psychological understanding over time? (8 marks)

The AO1 paragraph considers the development from PET to fMRI scans and provides accurate and thorough knowledge and understanding of this scanning technique, describing how it works and how it can be used. As a top-level response, previous AO1 paragraphs will have considered earlier scanning techniques in similar detail.

The second (AO3) paragraph considers two competing arguments, firstly stating that techniques have completely transformed psychology and secondly that there are problems with a reliance on scanning techniques alone. Using mostly coherent chains of reasoning this paragraph leads to a conclusion that scanning techniques are useful but other methods should also be employed by psychologists. This would make a particularly good final paragraph after previous AO3 points have justified/criticised different scanning techniques.

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